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• **Klingler Textil AG**

**9200 Gossau (SG) (CH)**

(72) Inventor: **Opitz, Oliver**

**83052 Götting/Bruckmühl (DE)**

(71) Applicants:

• **W.L. GORE & ASSOCIATES GmbH**  
**85640 Putzbrunn (DE)**

(74) Representative:

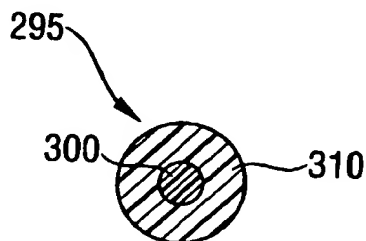
**Harrison, Robert John**  
**W.L. Gore & Associates GmbH,**  
**Hermann-Oberth-Strasse 22**  
**85640 Putzbrunn (DE)**

(54) **Yarn**

(57) A yarn (295) for use in protective clothing is taught. The yarn (295) is a cover-core yarn and has a core (300) made from a core fibre having a high longitudinal tensile strength with a sheath (310) made from sheath material having high abrasion resistance and containing particle receptors. The particle receptors are used to accept dyes for colouring the yarn or waterproofing chemicals for making the textiles made from said yarns more waterproof.

The core fibre (300) may be selected from the group of fibres comprising aramid fibres, polyamide fibres, polyethylene, graphite, glass, steel or polytetrafluoroethylene fibres and is preferably a paraaramid fibre. The sheath material (310) is selected from the group of materials comprising polyamides, polyester or cotton and is preferably polyamide 6.6.

***Fig. 5***



**Description**Field of the Invention

5 [0001] The invention relates to a yarn and a woven textile made from the yarn for protective clothing.

Prior Art

10 [0002] Several different methods for providing textiles suitable for use in protective clothing, such as protective clothing for motorcyclists, are known.

[0003] Typically motorcyclists' protective clothing has been made from leather which offers good protection against abrasion and sufficient shock absorption to protect the wearer in the event of an accident.

15 [0004] The use of other textiles are also known in the art. For example, German Patent Application DE-A-196 42 912 (Woods) teaches a protective textile from which protective clothing such as motorcyclist's clothing can be made. The protective textile has two layers. An outer layer is made from fibres which have a high disintegration textile and high mass in order to provide protection from abrasion. The inner layer is designed to act as a shock-absorbing layer.

20 [0005] W.L.Gore & Associates, Feldkirchen-Westerham, Germany, currently sell a liner laminate, known as a Z-liner, made using the techniques disclosed in EP-B-0 081 850 (Kleis) for use in motorcycle protection suits. This laminate consists of a waterproof but water vapour permeable functional layer, made of expanded polytetrafluoroethylene (ePTFE), and an outer shell of polyamide 6.6 or polyester. This laminate has the disadvantage, however, that when it becomes wet, water is collected between the outer shell and the functional layer and the protective clothing becomes substantially heavier.

25 [0006] It is possible to provide laminates in which an outer shell of polyamide 6.6 or polyester is laminated to an ePTFE functional layer. However, until the development of the invention described herein, the laminates did not offer sufficient protection to the wearer in the event of an accident.

[0007] Experiments have shown that the extent of protection offered by the material from which the protective clothing is made depends on the stability of the outer shell. This can be increased by providing materials with a heavier weight which, however, has the disadvantage that the weight of the protective clothing is increased. Alternatively one can change the material from which the outer shell is made.

30 [0008] An outer shell made of para-aramid yarn, such as Kevlar® yarn, would offer a suitable compromise between the weight of the clothing and the degree of protection offered to the wearer in the event of an accident. However, this yarn cannot be coloured and is therefore unsuitable for use where fashion or safety considerations dictate that the protective clothing needs to be coloured, it would be possible to use an outer shell made from a polyamide yarn, such as Cordura® yarn, which can be coloured. However, this is not as robust as Kevlar® yarn and is therefore unsuitable for protective clothing. A further disadvantage of the Kevlar® yarn is that it disintegrates in ultra-violet (UV) light. Schoeller - Textil in Switzerland have used a core spinning process in which they spin polybenzimidazol (PBI) fibres around a para-amide fibre to provide a yarn which is less susceptible to disintegration by UV light. This is described in Textilwirtschaft Sport, Jan. 98, pp. 78-81 in an article entitled "Wegweiser durch den Markendschungel" by Till Gottbrath, in particular on page 81. PBI fibres are, however, not colourable and thus this yarn is also unsuitable for use in applications in which the protective clothing needs to be coloured.

40 [0009] US Patent US-A- 4 868 041 (Yamagishi et al.) assigned to Toyo Bodeki K.K. teaches cloth made from yarns which have a core-sheath type structure. The core of the yarn is made from a polyamide fibre and cotton fibres are disposed about the core to form the sheath. The material is used to weave cloth offering protection against high temperature and flames.

45 Summary of the Invention

[0010] It is an object of the invention to provide a yarn which is highly abrasion-resistant but also capable of being treated to give it further properties.

50 [0011] It is furthermore an object of the invention to provide a yarn which is highly abrasion-resistant and colourable.

[0012] It is also an object of the invention to provide a textile laminate for use in protective clothing, such as motorcyclist's clothing.

55 [0013] These and other problems of the invention are solved by providing a yarn comprising a core made from a core fibre having a high longitudinal tensile strength and a sheath disposed about said core made from sheath material having high abrasion resistance and having particle receptors. This construction allows the manufacture of yarns which are extremely strong, abrasion resistant and colourable. Furthermore the sheath protects the core from degradation in its tensile strength that might occur, for example, by exposure to UV light. Since the core material has a high tensile strength, there is no requirement to choose the sheath material such that this material also provides the final yarn with a

high tensile strength. Instead material may be chosen which is highly abrasion resistant and has further advantageous properties such that it can be dyed or treated with water resistant chemicals. Preferably the sheath is spun about said core.

[0014] In this context particle receptors means that the fibres in the sheath material are able to chemically or physically bond with other particles. Some fibres have amorphous areas in their structure in which particles, such as dye particles, may be held by van der Waal's forces. Other fibres have reactive groups, such as an  $-NH_3$  group, to which the particles can chemically bond. Such particles include dye particles for colouring the fibres, water-resistant chemicals for improving the water resistance of the yarns made from the fibres or softeners for softening the yarns.

[0015] The core fibre of the yarn may be made from aramid fibres, polyamide fibres, polyethylene, graphite, glass, steel or polytetrafluoroethylene fibres and the sheath material is selected from the group of materials comprising polyamides, polyester or cotton. Most preferably the core fibre is a para-aramid fibre such as a KEVLAR<sup>®</sup> fibre and the sheath material is polyamide 6.6 such as CORDURA<sup>®</sup>. This combination has the advantage that the para-aramid fibre is protected from ultra-violet light which is known to degrade its strength properties and the polyamide 6.6 fibre has particle receptors which are amorphous areas in the fibre structures in which particles can be held by physical bonds.

[0016] Alternatively, the sheath material may be made of polyester which has amorphous areas in its structure in which particles can be held by physical bonds. If the sheath material is made of polyamide, then in addition reactive  $-NH_3$  groups are present in the structure to which particles may chemically bond.

[0017] The yarn may be made into a woven textile layer for lamination onto a waterproof and water vapour permeable functional layer. A textile is thus obtained which is not only highly abrasion resistant but also waterproof and "breathable". Such a textile has a variety of uses in protective clothing such as protective clothing for motorcyclists. Preferably at least one backer fabric is laminated onto the other side of said functional layer. This backer fabric can act as a thermal insulation layer and/or as a liner to improve the comfort of the clothing made from the textile.

[0018] In the preferred embodiment of the invention, the textile layer is woven from the yarn of the invention together with a second yarn to obtain a textile layer having a weight between 100 and 500 g/m<sup>2</sup>, and most preferably, between 250 and 500 g/m<sup>2</sup>. This second yarn is made from a material chosen from the group of polyamide, polyester, polybenzimidazol and cotton and is most preferably a polyamide yarn.

[0019] The functional layer is a membrane or a film and can be made from the group of materials consisting of polyesters, polyamide, polyolefins, polyvinylchloride, polyketones, polysulfones, polycarbonates, fluoropolymers including polytetrafluoroethylene, polyacrylates, polyurethanes, copolyetheresters, copolyetheramides. Most preferably the functional layer is made from expanded PTFE which is known to be highly waterproof and breathable.

#### Description of the Drawings

##### [0020]

- Fig. 1 shows a protective suit for a motorcyclist made from the yarn of this invention.
- Fig. 2a shows a cross section of the textile from which the protective suit is manufactured.
- Fig. 2b shows a cross section of the functional layer used in the textile of Fig. 2a.
- Fig. 3 shows the apparatus for preparing the functional layer for a laminate according to the invention.
- Fig. 4 shows a lamination apparatus.
- Fig. 5 shows the yarn according to this invention.

#### Definitions

##### Waterproof

[0021] Waterproof as used herein is meant having water-penetration-resistance (hydrostatic resistance) of 0.13 bar or more. This measurement is carried out using by placing a test sample with an area of 100 cm under increasing water pressure. For this purpose, distilled water with temperature of  $20 \pm 2^\circ C$  is used and the rate of increase of the water pressure was  $60 \pm 3 \text{ cmH}_2\text{O/min}$ . The water penetration resistance of the sample is then the pressure at which water appears on the opposite side of the sample. The exact method of carrying out this test is given in the ISO Standard No. 811 from 1981.

##### Water Vapour Permeable

[0022] Water vapour permeable as used herein is meant having a water-vapour-transmission rate RET of under 150 (m<sup>2</sup>.Pa) / W. The water vapour transmission rate is measured using the Hohenstein MDM Dry Method which is explained in the Standard-Prüfvorschrift (Standard Test Rules) No. BPI 1.4 dated September 1987 and issued by the

Bekleidungsphysiologisches Instituts e.V. Hohenstein, Germany.

# Functional Layer

5 [0023] The term functional layer is used to denote a layer which has the properties that it is both waterproof and water-vapour permeable.

## Yarn

10 [0024] The term yarn is used in the description is used to describe the continuous strands of material which are made into the textile. It includes strands, filaments, fibres and the like.

## dtex

15 [0025] This is a measurement commonly in use in the textile field. In metric units dtex is equivalent to g per 10,000 m of yarn. So, for example, yarn of 500 dtex has a weight of 500 g per 10,000 m of yarn.

## Detailed Description of the Invention

20 [0026] Fig. 1 shows a protective suit 10 for a motorcyclist made from the yarn according to this invention. As is shown in Fig. 2a a textile laminate 20 from which the protective suit 10 according to the invention is made is a three layer laminate in which an outer shell fabric 30 is made from a woven, non-woven or knitted yarn manufactured according to this invention. The outer shell fabric 30 is laminated onto the upper surface of a functional layer 40 on which other side is laminated a backer fabric 50.

25 [0027] The functional layer 40 is formed in one embodiment of this invention from a porous polymeric layer 60 and a continuous non-porous hydrophilic water vapour permeable polymer layer 70 as is shown in Fig. 2b. The porous polymeric layer 60 preferably used in this invention is a microporous polymer membrane having a microscopic structure of open, interconnecting micro voids. It exhibits air permeability and as such imparts, or does not impair, water vapour permeability. The microporous membrane used in the textile laminate 20 described herein is typically of a thickness of 5  
30  $\mu\text{m}$  to 125  $\mu\text{m}$ , most preferably of the order of about 5  $\mu\text{m}$  to 25  $\mu\text{m}$ . The useful polymers of the microporous membrane material include plastic polymers as well as elastomeric polymers. Examples of suitable polymers include polyesters, polyamide, polyolefins, polyketones, polysulfones, polycarbonates, fluoropolymers, polyacrylates, polyurethanes, copolyetheresters, copolyetheramides and the like. The preferred polymers are plastic polymers.

35 [0028] The most preferred microporous polymer membrane material is expanded microporous polytetrafluoroethylene (ePTFE). These materials are characterised by a multiplicity of open, interconnecting microscopic voids, high void volume, high strength, soft, flexible, stable chemical properties, high water vapour transfer and a surface that exhibits good contamination control characteristics. US Patents US-A- 3 953 566 and US-A-4 187 390 describe the preparation of such microporous expanded polytetrafluoroethylene membranes and are incorporated herein by reference.

40 [0029] The continuous water vapour permeable polymer layer 70 is a hydrophilic polymer. The hydrophilic layer selectively transports water by diffusion but does not support pressure-driven liquid or air flow. Therefore moisture, i.e. water vapour, is transported but the continuous layer of the polymer precludes the passage of such things as air-borne particles or micro-organisms. This characteristic imparts to the textile 20 including the porous polymer layer 60 and in turn to articles made from it, such as protective suits 10, good contamination control characteristics by functioning as a barrier to contaminants of all sizes. Furthermore the water vapour transmitting characteristics of the material allow for comfort characteristics to the wearer.

45 [0030] The continuous water vapour permeable polymer layer 60 is typically of a thickness of between 5  $\mu\text{m}$  and 50  $\mu\text{m}$ , preferably between about 10  $\mu\text{m}$  and 25  $\mu\text{m}$ . This thickness has been found to be a good practical balance to yield satisfactory durability, continuity and rate of water vapour transmission.

50 [0031] Although not limited to them, the continuous water-vapour permeable polymers most useful herein are those of the polyurethane family, the silicone family, the co-polyetherester family or the co-polyetherester amide family. Suitable co-polyetherester hydrophilic composition may be found in the teachings of US-A-4 493 870 (Vrouenraets) and US-A- 4 725 481 (Ostapachenko). Suitable hydrophilic compositions are described in US-A- 4 2340 838 (Foy et al.), Suitable polyurethanes maybe found in US-A-4 194 041 (Gore). A preferred class of continuous, water vapour permeable polymers are polyurethane, especially those containing oxyethylene units, such as described in US-A-4 532 316  
55 (Henn). Typically these materials comprise a composition having a high concentration of oxyethylene units to impart hydrophilicity to the polymer. The concentration of oxyethylene units is typically greater than 45% by weight of the base polymer, preferably greater than 60%, most preferably greater than 70%.

[0032] The functional layer 40 used to make the laminate 20 of this invention can be prepared according to the teach-

ings of US-A- 5 026 591 (Henn et al.). This method is illustrated but not limited to the following description of a four roll stack as shown in Fig. 3. Metered control of the molten water vapour permeable polymer 100 is provided for by a gravure roll 110 and a doctor blade/polymer reservoir 120. The water vapour permeable polymer 100 is applied as a thin, continuous liquid film 105 to the continuously moving porous polymer membrane 130 in the nip 140 between two rotating rolls 150, 160; the first one of the rotating rolls 150 having been coated with the liquid polymer and the second one of the rotating rolls 160 providing support so as to force the liquid polymer partially into the porous structure of the polymer membrane 130.

[0033] The outer shell fabric 30 and the backer fabric 50 are laminated to the functional layer 40 using a standard lamination process such as that illustrated in Fig. 4. For simplicity, Fig. 4 shows only the lamination of one fabric layer, i.e. either the outer shell fabric 30 or the backer fabric 50, onto one side of the functional layer 40. In the process, a dot pattern of heat-curing adhesive 170 from a doctor knife/adhesive reservoir 180 is metered onto the second side of the functional layer 40 by a gravure roll 190. The functional layer 40 is held under minimal tension against the gravure roll 190 by a low durometer rubber roll 200 at a pressure sufficient to effect removal of the adhesive dots onto the second side of the composite layer 5.

[0034] On exiting a printing nip 210, the adhesive dot coated composite layer 220 is brought to a laminating roll 230 where it is brought in intimate contact with the backer fabric 50 or outer shell fabric 30 provided from a storage roll 240. The laminate 250 created is cured at around 125°C and is then wrapped around a storage roll 260. Upon exiting the nip 270 between the roll 260 and a pressure roll 280, the laminate 250 is taken up on a storage roll 290.

[0035] A yarn 295 from which the outer shell fabric 30 is made is illustrated in Fig. 5 which shows a core 300 consisting of a first material around which is disposed a cover or sheath 310 made of a second material. The first material in the core 300 is in an embodiment of the invention an aramid fibre and more particularly a meta-aramid fibre such as a KEVLAR® fibre obtainable from E.I. Du Pont de Nemours, Inc. In another embodiment of the invention the core 300 is made from a fibre made of expanded polytetrafluoroethylene (ePTFE) such as a RASTEX® fibre obtainable from W.L.Gore & Associates. In a further embodiment of the invention the core 300 is made from a fibre made of high tenacity NYLON® (Polyamid 6.6) obtainable from Du Pont, Genera, Nylstar, Germany or Viscoswiss, Neuchateau, Switzerland. More generally the core 300 is made from a fibre of a first material which has a very high tensile strength. Table 1 shows the tensile strengths of the fibres which could be used as the first material in the core 300. The tensile strengths are measured by the German DIN Standard No 53 834 Part 1 dated February 1976 under normal climatic conditions of (20±2) °C and (65±2) % relative humidity as defined in German DIN Standard No 53 802.

Table 1

Material	Trade Name	Source	Tensile Strength measured under normal climatic conditions (cN/dtex)
Aramid	KEVLAR®	Du Pont	17-27
ePTFE	RASTEX®	W.L.Gore & Associates	0.8-1.8
Polyamide 6.6		various	4-6
Polyamide 6.6	High Tenacity Nylon	various	6-9
Polyamide 6.6	CORDURA® 550	Du Pont	5.9
Polyamide 6.6	CORDURA® 1100	Du Pont	5.18
Graphite		various	10-17
Glass		various	4-14
Steel		various	3-4.8
Polyethylene ND		various	3-7

Source: "Synthesfasern" by Dr. Béla von Fallai, Weinheim: Verlag Chemie, 1981.

[0036] The cover 310 is made from a second material which in one embodiment of the invention is polyamid fibre and more particularly a polyamide 6.6 fibre such as a CORDURA® fibre obtainable from E.I. Du Pont de Nemours, Inc. In another embodiment of the invention the second material used in the cover 310 is a NOMEX® fibre also obtainable from E.I. Du Pont de Nemours, Inc. Alternatively it would be possible to use a Polyamid 4.6 fibre obtainable from DSM Chemicals & Fertilizers in Sittard, The Netherlands. Alternatively the cover 310 can be made from a resin which coats

the core 300. More generally the second material used in the cover 310 is selected so that a highly abrasion resistant yarn is formed which can also accept dye particles. Examples of such fibres are polyamides, polyester or cotton

[0037] In the preferred embodiment of the invention the core 300 is made from KEVLAR® fibre about which are disposed CORDURA® fibres. The KEVLAR® fibre imparts to the yarn 295 a high tensile strength. The cover 310 is made from CORDURA® fibre which has a melting point of around 255°C and is highly abrasion resistant as will be described below. The CORDURA® fibre in contrast to the KEVLAR® fibre is resistant to degradation by ultra-violet light and may be dyed. The KEVLAR® fibre has a very high melting point of around 400°C such that even if the CORDURA® fibre melts, fabric 30 made from the yarn 295 retains its structure. Thus the yarn 295 produced is stable to ultraviolet degradation, may be dyed to produce textiles of a desired colour and has a high tensile strength. The dye particles are held by physical bonds (van der Waal's forces) in the cover 310.

[0038] It is envisaged that a cover 310 may also be made of polyester. This material has particle receptor comprising reactive groups to which, for example, dye particles can chemically bond. Chemical bonds are much stronger than physical bonds and thus it is thought that yarns 295 made from the cover 310 of polyester would be more colourfast.

[0039] The core 300 of the yarn 295 may be made from a single spun fibre, a multi-filament fibre or a so-called „stretch-broken" fibre having a plurality of torn fibres of approx 100 mm length whose ends interlock with each other. The single spun fibre has the highest longitudinal tensile strength. It is envisaged that a fibre of around 200 dtex would be used. This type of fibre is substantially more expensive than the stretch-broken fibre. A further type of fibre which may be used is a so called „cottonspun" fibre in which the torn fibres have lengths of approx. 38 - 40 mm. The cotton-spun fibre does not offer such a high longitudinal strength as the stretch-broken fibre or the single filament fibre. However, it is cheaper than either of the two other types of fibre.

[0040] The yarn 295 depicted in Fig. 5 is preferably made by wrapping the fibre forming the cover 310 around the fibre forming the core 300. Such techniques are known in the art and machines capable of carrying out such a process are obtainable from Rieter in Ingolstadt, Germany, and/or Schalfhorst in Mönchengladbach, Germany.

[0041] The yarn 295 thus produced may be woven or braided using known techniques, such as those using machines supplied by Dornier in Germany. The outer shell fabric 30 produced from the inventive yarn 295 may have be heavier or lighter in weight with a different number of threads per square centimetre. Furthermore the yarn 295 of the invention can be combined with other yarns in the outer shell fabric.

[0042] After weaving, the outer shell fabric 30 was laminated onto a functional layer 40 consisting of ePTFE and a polyurethane coating using the lamination techniques described in connection with Fig. 4. The backer fabric 50 was laminated onto the other side of the functional layer 40.

[0043] The three laminate layer forming the textile 20 for the protective suit 10 thus produced was then tested using an abrasion resistance test method. One such test method has been developed by the Technisches Universität in Darmstadt, Germany, (the "Darmstadt Method") and is described in the article „Schutzkleidungsprüfung und Entwicklungsmöglichkeiten" by A. Weidele in VDI Berichte Nr. 657, 1987, pp 263 - 279. This test involves dropping onto a concrete surface a disc of 125 cm diameter onto which pieces of the fabric of the invention are stretched. The disc is mounted on an arm set to spin around an axis at a speed of 60 km/h before dropping and is then allowed to come to a halt. The speed is chosen to represent the moment of inertia of a motorcyclist falling onto the surface of the road on his back. The circumference of the circular path travelled by the disc prior to coming to a stop is 900 mm. The surface pressure between the textile sample and the road surface is 1.875 N/cm<sup>2</sup> and is comparable to the pressure which a 75 kg motorcyclist having a height of 1.75 m would exert on the road surface on a fall. The results of the test are given by measuring the degree to which holes in the fabric are observed by visual inspection. In each case three samples were used with the fabric being mounted at different angles to the direction of rotation. An index for the degree of abrasion is assigned to each sample according to the following table:

Table 2

Abrasion Index	Value	Description
1	None	No holes formed
2	Small	Some holes formed on parts of the surface of the sample.
3	Partial	Areas of the surface of the sample had holes in them. In these areas there was no longer complete threads of materials
4	Severe	Holes formed on large parts of the surface of the sample.
5	Complete	Hole formation throughout the surface of the sample.

[0044] In addition an average value for the coefficient of friction of the material was calculated. This should lie between

0.7 and 1.1 in accordance with the requirements for motorcyclists' clothing. Smaller values would lead in the event of a real accident to unacceptably long slides which could result in a collision between a motorcyclist and another object. Coefficients higher than 1.1 lead to a risk of the motorcyclists "somersaulting" on the road surface which might result in fractured bones.

#### Example 1

[0045] An outer shell fabric 30 with a weight of 250 to 300 g/cm<sup>3</sup> was made from a mixture of the yarn 295 of the current invention and 500 dtex CORDURA<sup>®</sup> yarn obtainable from Du Pont. The yarn 295 of the invention was made with a core of 200 dtex KEVLAR<sup>®</sup> stretch-broken yarn obtainable from Du Pont wrapped with a cover of two approx. 370 dtex CORDURA<sup>®</sup> yarns obtainable from DuPont to give a yarn of around 1000 dtex. The yarn 295 was beat-set by beating it at 160 - 180 °C under tension.

[0046] The thus manufactured yarn 295 was woven together with the 500 dtex CORDURA<sup>®</sup> in which every fourth weft was a yarn 295 according to the invention and every fourth warp was a yarn 295 according to the invention. The outer shell fabric 30 was then laminated to a functional layer 40 comprising an ePTFE layer 50 coated with a polyurethane layer 70 and having a thickness of 0.9 mm to form a two layer laminate. A three layer laminate was made using a backer fabric of polyester with a weight of 30 g/m<sup>2</sup> laminated onto the other side of the functional layer 40.

#### Example 2

[0047] The yarn 295 of Example 1 is used in a different weave. In this example, the weft comprises 16 500 dtex CORDURA<sup>®</sup> yarns followed by two 1000 dtex yarns 295 of the invention. The weave comprises fourteen 500 dtex CORDURA<sup>®</sup> yarns and two 1000 dtex yarns 295 of the invention. The thus-woven outer shell fabric 30 is then laminated to the functional layer 40.

#### Example 3

[0048] The yarn 295 of Example 1 is used. Both the warp and the weft comprises two 1100 dtex CORDURA<sup>®</sup> yarns followed by a 1000 dtex yarn 295 of the invention. The thus woven outer shell fabric 30 is then laminated to the functional layer 40.

#### Example 4

[0049] The yarn 295 of the invention is made with a core of 100 dtex KEVLAR<sup>®</sup> stretch-broken or single filament yarn from DuPont around which a cover of two 180 dtex CORDURA<sup>®</sup> yarns are spun. This yarn is woven to form an outer shell fabric 30 and is laminated to a functional layer 40.

#### Comparative Examples

[0050] As a comparative examples, four existing fabrics were tested. The first comparative example was a two layer LEMANS fabric obtainable from W.L.Gore & Associates GmbH, Feldkirchen, Germany, having an outer shell comprising a mix of high tenacity polyamide 6.6 and CORDURA<sup>®</sup> yarn laminated to a functional layer comprising an ePTFE layer coated with a polyurethane layer. The outer shell had a weight of 225 g/m<sup>2</sup>.

[0051] The second comparative example was a Rökona jacket made from a mix of polyamide and polyester.

[0052] The third comparative example was a K300 fabric obtainable from Schöller. The K300 fabric is a polyamid 4-6 Kevlar woven fabric with a weight of 330g/m<sup>2</sup> and a Z-liner laminate.

[0053] The fourth comparative example was a CORDURA<sup>®</sup> 500 fabric obtainable from Magocchi in Italy.

[0054] Finally the fifth comparative example was 1.4 mm thick cowhide leather.

Table 3

Nr.	Material	Weight g/m <sup>2</sup>	Angle	Starting Speed	Average coefficient of friction	Abrasion Index	Weight Loss %
Example 1	<b>Two layer laminate</b>	313,2	0	63,3	0,5	3	15
			45	58,8	0,42	3	14
			90	61,2	0,47	2	11
Example 2	<b>Three layer laminate</b>	344,0	0	58,6	0,41	2	8
			45	61,9	0,48	3	13
			90	61,7	0,46	2	12
Comparative Example 1	<b>LEMANS</b>	256,8	0	62,1	0,46	2	22
			45	59,6	0,44	4	30
			90	62,8	0,5	5	42
Comparative Example 2	<b>Rökona</b>	285,3	0	58,8	0,33	4	9
			45	61,5	0,36	3	9
			90	63,1	0,35	2	4
Comparative Example 3	<b>K(300+ Z Heavy</b>	332,0 + 111,5	0	63,8	0,48	1	8
			45	60,2	0,43	2	9
			90	59,3	0,41	3	11
Comparative Example 4	<b>CORDURA® 500</b>	268,7	0	58,5	0,44	3	17
			45	63,2	0,51	3	19
			90	61,7	0,48	3	20
Comparative Example 5	<b>Leather 1.4 mm</b>	828,6		59,2	0,66	1	5

[0055] As can be seen by considering the results of table 3, the index of abrasion for the two layer and three layer laminates made according to the invention is under the value of three. The textiles of comparative examples 1 and 2 both show indices of abrasion greater than three. It will also be noted that the percentage weight loss of the two and three layer laminates made according to the invention is substantially less than that of the laminate of comparative example 3. Comparative examples 3 and 4 both show indices of abrasion less than three. However, their weight is high which means that garments made from these materials are heavy. A garment made from CORDURA® 500 material would be comparatively light. However, since this material does not contain a waterproof functional layer, it is not as waterproof as the textile laminates of the invention or the laminates of comparative examples 1 and 3.

#### Claims

##### 1. Yarn (295) comprising

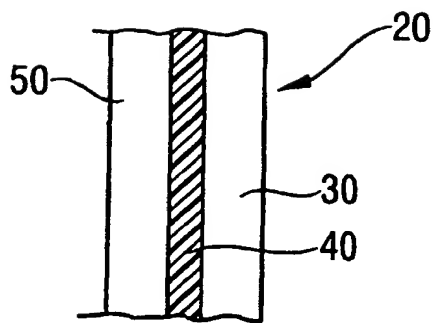
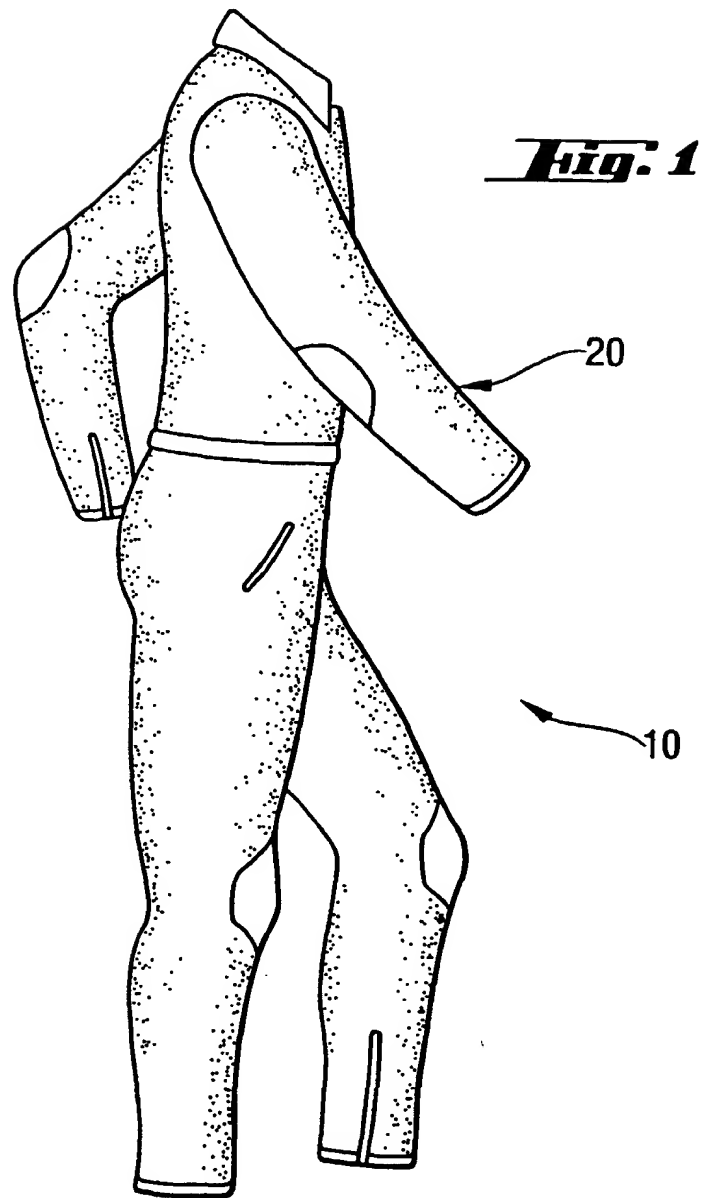
a core (300) made from a core fibre having a high longitudinal tensile strength,  
a sheath (310) disposed about said core (300) made from sheath material having high abrasion resistance and particle receptors.

##### 2. Yarn (295) according to claim 1 wherein said sheath (310) of the yarn (295) is spun about said core (300).

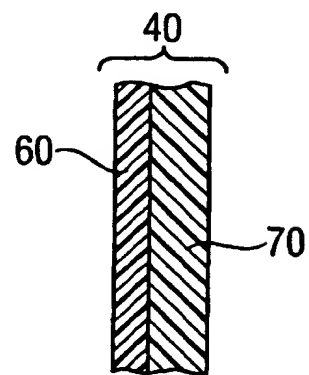
##### 3. Yarn (295) according to claim 1 wherein said core (300) has a longitudinal tensile strength greater than 0.8 cN/dtex



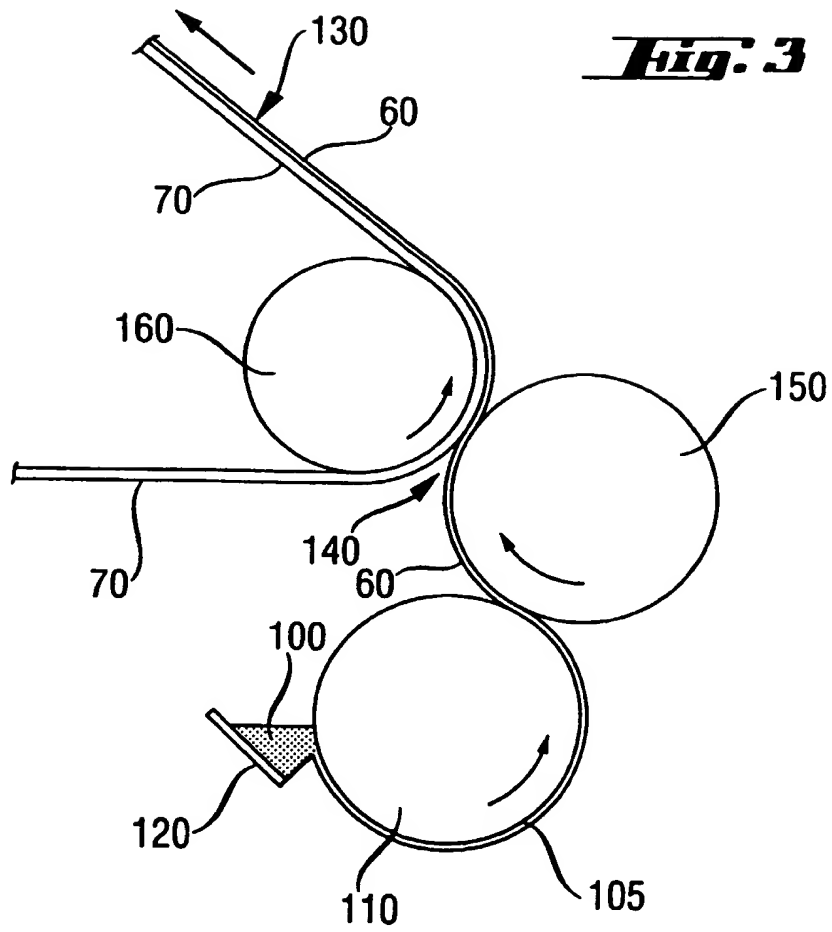
4. Yarn (295) according to claim 1 wherein said core fibre (300) is selected from the group of fibres comprising aramid fibres, polyamide fibres, polyethylene, graphite, glass, steel or polytetrafluoroethylene fibres.
5. Yarn (295) according to claim 4 wherein said core fibre (300) is a para-aramid fibre.
6. Yarn (295) according to claim 1 wherein said sheath material (310) is selected from the group of materials comprising polyamides, polyester or cotton.
7. Yarn (295) according to claim 6 wherein said sheath material (310) is polyamide 6.6.
8. Yarn (295) according to claim 1 wherein said core fibre (300) is made from a plurality of fibres having frayed ends intertwined with each other.
9. Yarn (295) according to claim 1 wherein said core fibre (300) is a multifilament fibre.
10. Yarn (295) according to claim 1 wherein the abrasion resistance of said sheath material (310) is such that woven textile made from said yarn (295) and having a weight of 300-400 g/m<sup>2</sup> has an abrasion index <3 when a disc is dropped from a height of 1 cm resulting in a pressure of 1.875 N/cm<sup>2</sup> and spinning at a speed such that its circumferential speed is 55-65 km/hr onto a concrete surface.
11. Yarn (295) according to claim 1 wherein said particle receptors accept dye particles.
12. Woven textile made from yarn (295) of claims 1 to 11.
13. Protective clothing (10) made from the woven textile (30) of claim 12
14. Protective clothing (10) of claim 13 in which the woven textile (30) is laminated to a waterproof and water-vapour-permeable functional layer (40).
15. Protective clothing (10) of claim 14 in which a backer fabric (50) is laminated to the waterproof and water-vapour-permeable functional layer (40).



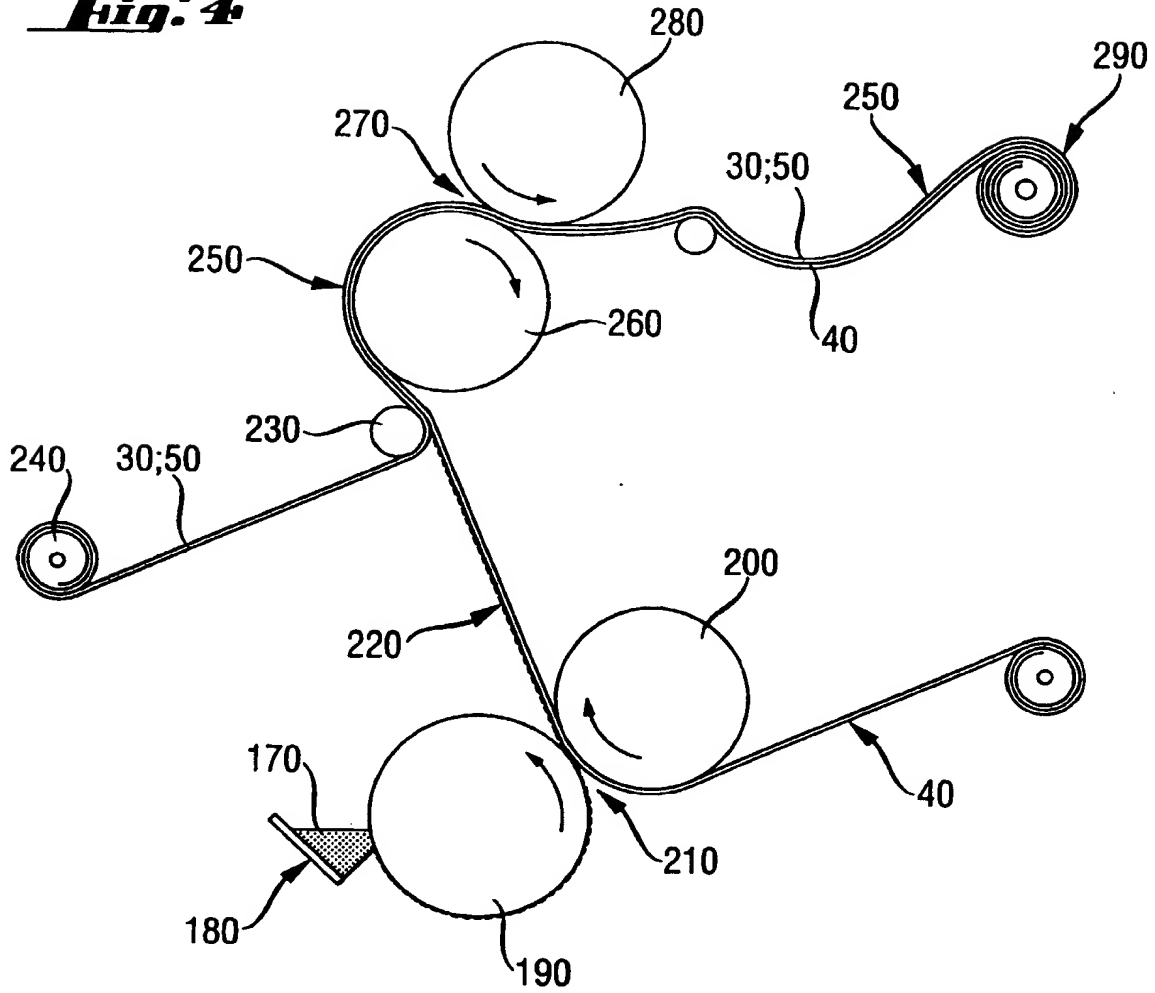
***Fig. 2a***



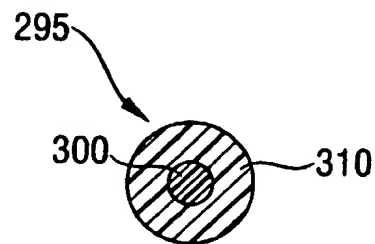
***Fig. 2b***



**Fig. 4**



**Fig. 5**





European Patent  
Office

# EUROPEAN SEARCH REPORT

Application Number  
EP 98 11 0328

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	US 4 381 639 A (KRESS, R.R.) 3 May 1983 * column 1, line 21 - column 2, line 40; claims 2, 4 *	1, 2, 4, 9	D02G3/36 D02G3/44
A	---	12, 13	
Y	US 4 331 729 A (WEBER, J.W.) 25 May 1982 * column 1, line 42 - column 2, line 55; claims 1, 3, 9; figures 1, 2 *	1, 2, 5, 11	
A	---	12, 13	
Y	PATENT ABSTRACTS OF JAPAN vol. 98, no. 10, 31 August 1998 & JP 10 130990 A (MORIKAWA NENSHI KK), 19 May 1998 * abstract *	1, 2, 5, 11	
A	---	12, 13	
A	FR 2 599 762 A (FILATURE DE LA GOSSE S.A.) 11 December 1987 * the whole document *	11	
A	PATENT ABSTRACTS OF JAPAN vol. 97, no. 7, 31 July 1997 & JP 09 078379 A (TORAY IND INC.), 25 March 1997 * abstract *	1, 12, 13	TECHNICAL FIELDS SEARCHED (Int.Cl.6) D02G A41D
The present search report has been drawn up for all claims			
Place of search <b>THE HAGUE</b>		Date of completion of the search <b>20 November 1998</b>	Examiner <b>Munzer, E</b>
<p><b>CATEGORY OF CITED DOCUMENTS</b></p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons &amp; : member of the same patent family, corresponding document</p>			

